



Contact EAD  
Staff Directory  
Organization  
Chart

EAD Profile  
Programs/  
Projects  
Publications  
Working  
with EAD

Home  
Web Map  
Web Index  
Search

Resources

Main Topics

Navigate

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*Getting It Right at Weldon Spring by M. MacDonell, M. Picel, and J. Peterson*

How long does it take to get a massive federal cleanup project off the ground? "As long as it takes to get the community involved in the process," answers Steve McCracken, U.S. Department of Energy project manager for the Weldon Spring site in Missouri. "We really started out on the wrong foot by making our cleanup decisions in a vacuum," admitted McCracken. "But then we worked hard to open up the process, and we gained the community's acceptance and trust one at a time. Their support has been absolutely invaluable to us. Within a year, we were out in the field doing small-scale work, and we are now well along toward finishing the cleanup of this site and safely disposing of all its waste."

The DOE is planning and conducting cleanup activities at hundreds of sites across the country in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. This process directly applies to sites on the National Priorities List (NPL) of the U.S. Environmental Protection Agency (EPA). A number of DOE environmental restoration sites are on this list, including the Weldon Spring site. The estimated price tag for this cleanup project approaches \$1 billion, and the cost of DOE's overall program has been estimated at more than \$200 billion.

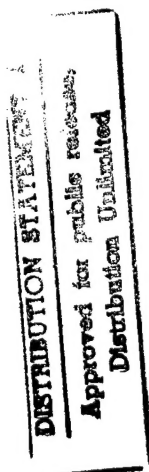
Few cleanup efforts can match the progress that has been made at the site. The project's success has not been without its share of adventure, and highlighting some of the lessons learned may help others facing similar challenges at cleanup sites across the country. A description of some of the hurdles that have been overcome at the Weldon Spring site follows, after a brief overview of the site's contamination problems.

### SITE BACKGROUND

The Weldon Spring site is about 30 miles west of St. Louis, Missouri; it consists of a 217-acre chemical plant and a 9-acre quarry. The site was both radioactively and chemically contaminated as a result of past processing and disposal activities. The U.S. Army used the chemical plant to produce nitroaromatic explosives, such as trinitrotoluene (TNT), in the early 1940s. It was then used by the U.S. Atomic Energy Commission (AEC) in the 1950s and 1960s to process uranium and some thorium ore concentrates.

The chemical plant consisted of about 40 structures and four waste ponds that covered about 25 acres and contained over 200,000 cubic yards (yd<sup>3</sup>) of contaminated sludge and 57 million gallons of water. Airborne emissions during the operational period resulted in low-level surficial soil contamination. There were also several old dump areas. The quarry, used by both the Army and the AEC as a waste pit, contained about 100,000 yd<sup>3</sup> of waste, including debris in direct contact with surface water at the base of the quarry. Groundwater is contaminated at both locations.

The total volume of contaminated material at the site (primarily



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sludge, soil, building material, and equipment) is just under 1 million yd<sup>3</sup>. The primary contaminants are uranium, radium, thorium, several nonradioactive metals (such as arsenic and chromium), asbestos, nitroaromatic compounds, and polychlorinated biphenyls (PCBs).

The site is adjacent to an Army training area (also an NPL site) and a popular state wildlife area. About 1500 students attend a high school within one-half mile of the chemical plant, and a well field that serves 63,000 county residents is located within a mile of the quarry. The public has been understandably concerned about contaminant releases, both from deteriorating conditions and from cleanup activities.

### **INITIAL PLAN REJECTED**

The Weldon Spring site had been inactive for about 20 years when a remedial action office was established in 1986. In early 1987, several months after the U.S. Congress passed the CERCLA amendments, the DOE issued a draft environmental impact statement (EIS) for site cleanup that identified on-site disposal as the preferred alternative. The community vigorously opposed this option, and people turned out in force at a public hearing to make sure their voices were heard, as they had at previous meetings where on-site disposal was discussed. About 2000 protests were lodged at the meeting on the draft EIS, which extended into the early morning hours. The DOE was also lambasted by regulatory agencies and the press.

As the DOE began to reevaluate its plans, it was discovered through ongoing monitoring that groundwater beneath the chemical plant was contaminated. This prompted an announcement of the intent to issue a revised draft EIS that would respond to comments and also incorporate the new information. The EPA Region VII formally requested that the DOE instead prepare a remedial investigation/feasibility study (RI/FS) pursuant to the requirements of CERCLA, as amended, which are specifically geared to contaminated sites. The DOE agreed to prepare an RI/FS-EIS that integrated both decision-making processes.

Field work ordinarily would have been conducted only after a comprehensive decision had been reached for waste disposal, which is one of the stickiest issues for contaminated sites. However, certain site problems--notably contaminant migration from the quarry wastes toward the county well field--were considered time-critical. In fact, the potential impact on this drinking water supply contributed to the site having among the highest scores of all sites on the NPL. The new, integrated process helped resolve the dilemma of needing to start cleanup while also knowing it could be years before a waste disposal decision was reached.

### **A PHASED APPROACH: PUTTING THE WHEELS IN MOTION**

Rather than wait for many more years of study to be completed, the DOE, working together with Argonne National Laboratory (ANL) (the environmental compliance contractor) and MK-Ferguson Company [the project management contractor (PMC)], developed an aggressive plan to move ahead with those focused actions that would clearly help protect human health and the environment in the near term. The disposal issue was addressed by determining that wastes generated by

these interim actions would be placed in controlled storage onsite pending the eventual disposal decision (except for PCB wastes that could readily be sent to a licensed facility). In parallel, the comprehensive waste disposal options would be reevaluated in greater technical detail through the RI/FS-EIS process, in coordination with the community.

By applying this outcome-oriented approach, the DOE was able to achieve significant cleanup progress without holding the entire site hostage to the final disposal decision. This emphasis on taking action early meant that the DOE could begin to spend project funds on actual field cleanup instead of on only "standby surveillance and maintenance" and paperwork, several years ahead of what would otherwise have been possible. Phased implementation also enhanced overall project management. Lessons learned from the smaller, straightforward activities made the later, complicated field work more effective and cost-efficient. The project office also made a strong commitment to involve oversight agencies and the community in the planning and decision making for these interim actions.

Dan Wall, the EPA remedial project manager responsible for overseeing cleanup activities at the Weldon Spring site, believes the phased approach had a very positive impact on the outcome of the project. "A big key to the project's success was that it took full advantage of the flexibility provided under CERCLA to implement interim actions. I believe that pursuing a range of focused actions that all stakeholders could readily agree on paved the way for long-term success years before the primary record of decision was developed. It demonstrated that DOE was responsive to the public's concerns, and it enabled them to get a lot of work done in a very timely manner."

The stepwise cleanup began with several small removal actions that helped stabilize the site and addressed obvious problems. These included

1. constructing a berm to divert surface runoff around an old dump area (which resulted in a striking decrease in the levels of uranium being carried off-site into the wildlife area after a rain or snowmelt)
2. collecting old PCB-contaminated transformers (which were not radioactively contaminated) and sending them off-site to a licensed disposal facility
3. consolidating discarded drums and other containers of wastes and laboratory chemicals scattered across the chemical plant
4. taking down unstable power lines and poles
5. dismantling support buildings, such as the old administration building and steam plant, that were relatively lightly contaminated.

During the second phase of interim actions, the highly contaminated process buildings were dismantled, and surface waters from the quarry and waste pits at the chemical plant area were treated and released to the nearby Missouri River. Wastes that had been dumped into the quarry 25 to 40 years earlier and were the source of groundwater contamination that threatened the well field were excavated and

transported to the chemical plant area for storage pending the overall disposal decision.

From 1987 through 1991, the plans for these individual cleanup actions were presented in streamlined environmental documents and closely coordinated with regulators and the public. Wastes generated by each of the interim actions were placed in controlled storage at the chemical plant, except for the PCB wastes, which were sent off-site. For example, asbestos from building decontamination was double-bagged and placed in SeaLand containers at the northeast perimeter of the site, while building materials and equipment were segregated by type and placed on a newly constructed storage pad in the northern portion of the site. Mixed wastes from the chemical consolidation activity were containerized and stored in a refurbished building in the southeast section of the site, and wastes from the quarry and the water treatment activities were placed on an engineered pad nearby.

These staging/storage areas were intentionally sited to avoid the central area; this area was considered to be the most suitable for construction of an engineered disposal cell (per the underlying soil material and hydrogeology). The project staff planned its activities always looking to the future so that whatever option was eventually selected could be efficiently implemented. Finally, the full-scale remedial action plan that addressed residual contaminant levels for soil and the comprehensive plan for waste disposal was presented in the RI/FS-EIS and discussed with the community in 1992.

## REACHING OUT

Poor communication and fear of the unknown had led many in the surrounding community to think the worst of the DOE. To help demystify the site, the DOE implemented an open-door policy under which the project staff were readily accessible and available to discuss the project with anyone at any time. They extended an open invitation to visit the site. They also "took their show on the road," talking about the site to groups that ranged from local industries, the Chamber of Commerce, and county agencies to parent-teacher organizations, the school board, local universities, and former site workers.

The DOE established a schedule for regular meetings with oversight agencies and the community (monthly to quarterly) to discuss evolving plans and analyses. In addition, the project staff held open houses and topical workshops at the site, where such issues as geosciences, treatment technologies, and risk assessment were discussed, and they distributed quarterly project updates in the local newspaper. They also established a science-mentoring program with the local schools, making presentations to grade- and high-school students and helping them with science projects under the "Partners in Education Program." Several local university and agency scientists also collaborated on studies that helped answer site-specific questions about contaminant leaching, biological uptake, and biotreatability.

The project office learned a great deal from these interactions. For example, past site workers provided valuable data about the types and locations of contaminated material (e.g., where hundreds of thorium drums had been placed in the quarry). Local residents identified where

private wells were located. State agencies described local land use and activity patterns and provided data on local and regional water quality and background levels of metals in soil. Agency scientists and university professors provided data on soil types and distribution coefficients that contributed to the evaluation of leaching and treatability of site contamination. Each of these pieces of information was important to ensuring that the site cleanup would protect workers, the public, and the environment. Also important was the ongoing communication that brought the participants more closely into the planning and decision-making process for the site.

Progress made by the project reflects the old Hollywood truism: It takes 20 years to become an overnight success. Working closely with regulatory agencies and the community over several years reversed the difficult situation of the mid-1980s. Those who had previously distrusted and spoken harshly of the DOE began to accept the project and even to praise how the site was being managed. By 1991, newspaper editorials encouraged the community to work with the DOE and give the project office a chance to do its job. Comments at the public meetings had become supportive rather than antagonistic, and one of the local activists now described the Weldon Spring site as the "jewel in the crown" of the DOE's cleanup program.

In 1992, the DOE again put forth its proposal on what to do with the site wastes. Again, on-site disposal was the preferred alternative, but this time, community acceptance was nearly unanimous. In fact, almost all the comments at the public meeting were from local workers who wanted to be hired for the upcoming cleanup. The difference was that this time, the project staff had a more extensive evaluation that better addressed the technical issues, but more importantly, the project staff had worked with the community to come up with solutions to the problems, one at a time, during the past 5 years. By joining with the state agencies and the public to ensure that their major issues were addressed, the project staff changed the atmosphere from "us against them" to "we're all in this together," and it was an extremely rewarding experience.

Perhaps the striking shift in the community's perception of the Weldon Spring project is best reflected in a comment made by a member of the community at the 1992 public meeting: "I am very comfortable that this report is based on the best available methodology and comprehensive in its considerations. I also believe that the preferred Alternative (6a) of the Department of Energy was the result of a very careful evaluation .... I fully concur with this alternative."

Major progress has been made at the site since the 1992 meeting. All the buildings have been taken down, the wastes have been removed from the quarry, and surface water at the quarry has been treated. Treatment of the water from the waste pits at the chemical plant is ongoing, and some of the sludge from these waste pits has been successfully treated as a pilot-scale project. In addition to all the lessons that were learned during decision making, a great deal more have been learned during the planning and actual performance of the work. Site workers were encouraged to be continually aware of possible safety issues and to develop solutions before serious problems could arise. Several of the practical field lessons developed by the PMC are discussed below.



## IMPLEMENTATION LESSONS

The health and safety of workers and the public are primary concerns at any contaminated site, especially when work involves taking down deteriorating buildings and handling large volumes of waste in constrained spaces. An integrated program that constantly emphasized worker safety and control of contaminant releases was critical to the success of the Weldon Spring project. In response to safety and exposure concerns as major cleanup work got under way, the project staff held daily meetings to review work plans and activity-specific safety procedures, conducted multiple training classes, established a program to document and regularly review lessons learned, and implemented a policy to have a safety inspector present during all field work. The extensive monitoring program was also expanded to ensure that the public would not be affected by site releases.

The project assembled multiple bid packages for a variety of work, and one of the lessons learned was to group these packages to maximize the effectiveness of trained work teams (e.g., for dismantling buildings). The DOE also found that obtaining independent engineering reviews of bid specifications and implementation plans provided practical approaches to specific problems. Comprehensive understanding of site policies for worker protection became an issue as more and more subcontractors were brought on-site to conduct cleanup work. Because of the concern that key information might get lost in translation, site policies and standard operating procedures for worker protection were incorporated into the subcontract documents.

To help maintain constant awareness of the importance of safety measures, the DOE conducted frequent and unscheduled health and safety inspections. Reviews ranged from the angle of stairways in the new water treatment plants and office trailers and the layout of these facilities per National Fire Protection Association requirements to respirator checks and the proper use of equipment and spotters. The DOE also strongly emphasized compliance with the project's worker safety program to the many subcontractors brought on board to conduct focused cleanup tasks.

Worker risks associated with high temperatures were a serious concern during the summer months. In response, workers were routinely monitored for symptoms of heat stress. In addition, risk analyses were conducted to estimate exposures to workers not wearing respirators, and air-monitoring data were used to make informed trade-offs between using protective equipment for exposure control and scaling back to control heat stress. This evaluation of trade-offs was an ongoing process. For example, on a day when temperatures soared above 90 degrees and humidity was high, the monitoring data inside one of the buildings indicated that protective hoods and respirators could be removed. However, workers contaminated their necks and chins when flaky material fell from the ceiling as they dismantled it. For the rest of the decontamination work, they replaced their hoods and wore face shields, but not respirators.

Using tiered levels of personal protection was a critical safety issue for the project regardless of weather. This type of equipment limits both visibility and the ability to communicate with others, which are two

factors that are extremely important to working safely. Near the end of the building decontamination activities, one worker was injured because protective gear limited the sight and hearing of another worker who was maneuvering a piece of heavy equipment in the area. The equipment caught a power wash hose that had been tied to a structure on which the first worker was standing, and everything was pulled to the ground. After this occurrence, breakaway tieoffs were used with all hoses and ropes, and constant awareness of all potential hazards was again emphasized to workers.

Extreme summer heat led to the unexpected penetration of contaminants through workers' protective polyester/cotton clothing during handling of contaminated piping. Workers who were sweating profusely rested heavy pipes on their thighs as they took them out of the process buildings, and contaminants were apparently transported through the wet clothing onto the skin. In response, impermeable leg coverings, gloves, and knee pads were used for the rest of this work, and workers were cautioned against kneeling in wet areas. Those activities with higher potential for exposures when personal protective equipment was scaled back to offset potential hazards were rescheduled to cooler months whenever possible.

Another surprise was encountered during the removal of horizontal process pipes from the chemical plant buildings. Some pipes still contained radioactive residues, which spilled when cut segments were tipped while being lowered to the ground. New procedures were developed to control any future releases; small holes were cut in horizontal pipes while they were still in place, then the contents were vacuumed out, and the ends were covered with polyethylene before the pipe segments were lowered to the ground.

Torch-cutting metal inside the buildings created two hazards for workers: fire and exposure to fumes. Initially, only a single fire watch was on duty in a man basket during elevated torch work. However, as workers were cutting girders overhead one day, someone on the ground happened to notice material burning on the floor beneath them. From that point on, two fire watches, one in the basket and the other on the ground, were used during this type of work. Workers could also be exposed to cadmium and lead in fumes generated from the torching operations, so appropriate use of local ventilation was essential. In a few instances, however, either no exhaust or only one was used for separate torching activities, or it was placed too far (more than 2 feet) from the fume source. Work was stopped when these errors were identified, and it did not recommence until personnel were further trained on the proper use of local exhaust. Fume levels were also controlled through constant awareness of generating sources. For example, carbon monoxide levels were reduced by simply turning off engines when equipment was not in use.

Just as trade-off evaluations were used to assess worker protection while dismantling the buildings, workers excavating wastes from the quarry applied an observational approach combined with real-time monitoring, using staged levels of worker protection to balance the risks of heat stress and visual limitations with exposures to contaminated materials. Contingency plans were developed to address possible deviations from expected conditions as excavation progressed into deeper levels of the quarry waste. Work would have progressed



very slowly had the standard full-protection approach been used for all activities regardless of the actual potential for exposure.

In fact, the observational approach concept represented one of the first lessons that had been learned at the quarry. Through this approach, the project was able to use existing information rather than spend hundreds of thousands of dollars to further characterize material in place when the decision to remove it was obvious. Following discussions with the oversight agencies, it was agreed that available data would be used to develop a streamlined risk evaluation for the action, with response plans based on the observational approach. The quarry material was then characterized as it was removed, with clean material being separated from contaminated wastes. This same general approach was also applied to dismantling the buildings, with a "rolling" incorporation of lessons learned.

Potentially serious safety issues arose during the hauling of quarry wastes in confined areas. The truck drivers had difficulty seeing (e.g., while backing up and traveling around curves on the haul road) because of tight spaces and vibrating exterior mirrors. Engineering and operational modifications were implemented to address this problem and to minimize the possibility of injuries or spills. Stabilizer bars were added to the mirrors to reduce the vibration and related blurring, a flashing yellow light was wired to the standard backup alarm to increase awareness of truck movements, and dedicated turnout areas were used in conjunction with trained spotters on the haul road to limit the potential for accidents.

The reevaluation of engineering options was also critical to the loading and transporting of quarry wastes. Initially, rolloff boxes were used to minimize tracking of contamination. However, this resulted in considerable delays because of the time needed for loading and unloading. An operational change to the use of tarped dump trucks and decontamination washes allowed schedule recovery through an alternative safe method. It was later found that certain wastes were sticking to the bottom of the truck beds, which required workers to dig out large amounts of material that would not "dump." In response, the beds were coated with graphite paint, and wetter material was loaded first to reduce contact and caking of the drier, more clayey soil. Wastes from each of the project activities were segregated by type, and controlled piles were favored over further containerization to minimize subsequent handling requirements and related exposures.

Another lesson learned involved the use of decontamination wash water. Initially, large volumes of clean water were obtained from water trucks to wash truck exteriors and power wash the quarry walls. After considerable delays associated with obtaining and pressurizing wash water, the effluent from the adjacent water treatment plant was tapped as a readily available and convenient source, which saved considerable time and money. Water was also regularly used to suppress dust, and a number of iterations were needed to optimize the amount of wetting per activity.

The mode of operation of the water treatment plants also provided a valuable lesson for the project. The community was concerned about effluent being released to the Missouri River without its having been tested to ensure that the cleanup levels had been achieved. In response,

a batch release system was incorporated into the facility design. Two effluent ponds were constructed so that treated water could be pumped to the second after the first was filled, and samples were tested prior to each discharge. This approach has worked well and helped alleviate public concerns.

Each of the procedures that were implemented to protect site workers also protected the public off-site, as contaminant releases from all activities were minimized at the source. As an example, the public had voiced significant concerns about impacts at the high school during building-dismantling activities. The project manager studied the site-specific risk analyses, modeling results, and engineering control plans and then made an informed commitment to the community that releases associated with this work would be controlled to such a level that there would be no measurable differences from background concentrations at the high school. Through a strong program of activity-specific engineering controls, dust suppression, and work sequencing, the project met this commitment.

### **SUMMARY**

The Weldon Spring project has achieved considerable success, gaining the support of the community and oversight agencies within the last several years and making striking progress on safe and effective cleanup that will bring the site to its end state within the next few years. What was the main ingredient of the project's success? McCracken believes it was the personal effort and long-term commitment of many local citizens and regulators, who helped project staff keep the site off the typical merry-go-round that had other waste sites going around in circles. "They really pitched in to help us get on with our work. By coming together regularly and really listening to each other, we all began to understand our different viewpoints. And we realized early on that we agreed on the most important thing: the need to take care of this site without delay. Then it was just a matter of trying to make the best decisions we could, talking over the key issues together, and agreeing that it was okay to disagree on some of the smaller things, while never losing sight of that common goal. If you have sound analyses and are working as a team, the implementation of those decisions becomes relatively easy."

McCracken also pointed to the importance of the project's rigorous safety program. "Maintaining a safe work environment at a site like ours is a tremendous challenge, and our workers have done an outstanding job. Emphasizing and demonstrating our absolute commitment to safety helped build the community's trust in our ability to do our job well and ensure their protection throughout the entire cleanup process." Those involved in the project look forward to that day in the near future when the Weldon Spring team celebrates successful completion and moves on to tackle other challenges.

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